IOWA STATE UNIVERSITY
Veterinary Microbiology and Preventive Medicine

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Effects of *Saccharomyces cerevisiae* fermentation product supplementation on the acute-phase response during bovine respiratory disease in neonatal calves' respiratory disease

Abstract

Bovine respiratory disease complex (BRDC) is a multi-pathogenic interaction often resulting in lower respiratory tract infections in cattle. BRDC commonly presents as a primary viral infection, followed by a secondary bacterial infection, resulting in clinically severe disease that can be fatal in neonatal calves. There has been research on the calves' immune response to the individual infections, but little has been done to study the immune response to a viral-bacterial co-infection. Supplementation with *Saccharomyces cerevisiae* fermentation products (SCFP) has shown to have positive effects on performance, health and immunity in cattle. A recent study demonstrated that supplementation of neonatal calves with the SCFP products, NutriTek and SmartCare, modulated the immune response in calves and improved the outcome of an experimental bovine respiratory syncytial viral (BRSV) infection[1]. This study's objective is to evaluate the effects of SCFPs on the acute phase response through quantitative gene expression for inflammatory cytokines: TNF-alpha, IL-1, and IL-6 from tissue using qPCR in a viral and bacterial co-infection in neonatal calves and correlate the findings with immune function and performance. Current results suggest that with a minimal increase in cytokine response, treated calves cleared the infection(s) with a better success rate following peak viral load.

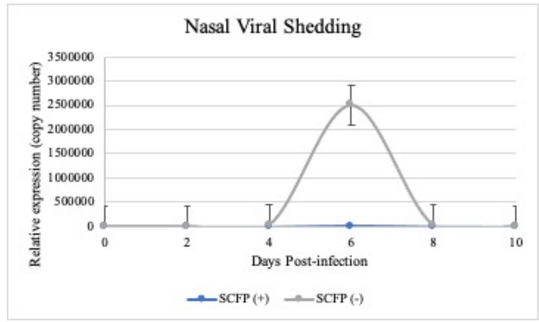
Methods

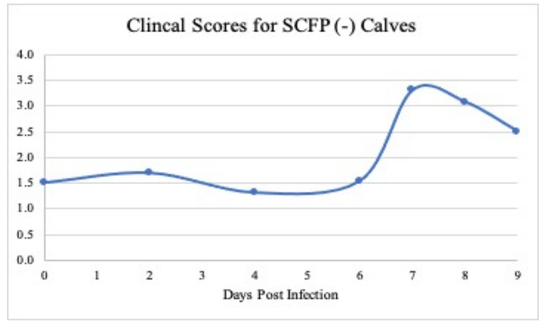
- 28 Holstein x Angus calves enrolled in the study and were organized by body weight and randomly divided into 2 treatment groups: SCFP (+) and SCFP (-)
- Collected baseline samples followed by sample collection every 2 days post viral infection until necropsy (D0, D2, D4, …)
- Baseline liver biopsy collected prior to viral infection for quantitative analysis following the study
- Calves received primary viral infection with aerosolized ~10^4 TCID 50 BRSV strain 375
- On D6 post-viral infection, calves received bacterial infection via intratracheal inoculation of ~10^8 colony forming units of *P. multocida* strain P1062 type A:3
- Collected liver biopsy during necropsy for quantitative analysis following the study
- RT-qPCR analysis of nasal swab for viral load analysis
- RT-qPCR analysis of pre-infection liver biopsy for baseline cytokine expression analysis
- RT-qPCR analysis of necropsy liver biopsy for final cytokine expression analysis

References

1. Mahmoud, A., Slate, J., Hong, S., Yoon, I., & McGill, J. L. (2020, August 11). Supplementing a Saccharomyces cerevisiae fermentation product modulates innate immune function and ameliorates bovine respiratory syncytial virus infection in neonatal calves. Retrieved August 13, 2020, from https://academic.oup.com/jas/advance-article/doi/10.1093/jas/skaa252/5891219

SCFP (+ / -) Comparisons





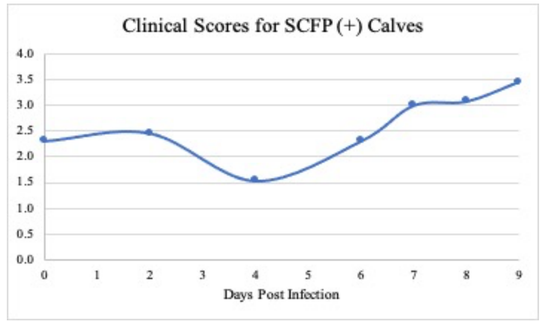
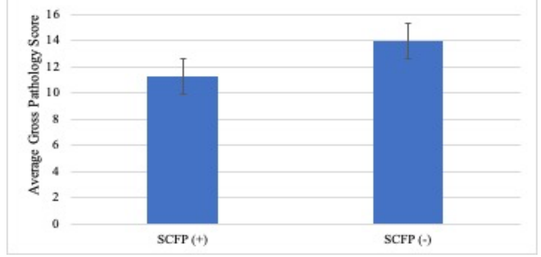
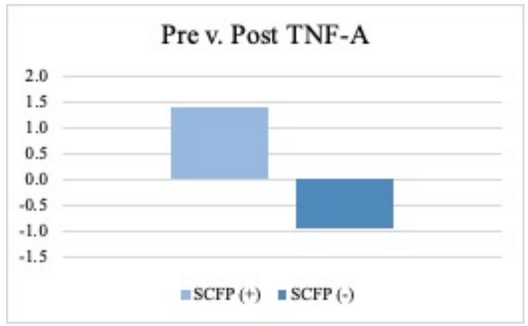
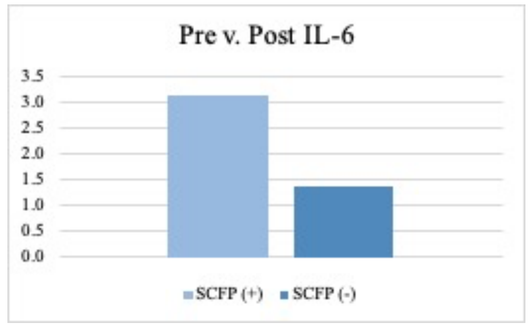


Figure 1. Impact of SCFP on nasal viral (BRSV) load. Treatment groups include: SCFP (-) (n=12) with coinfection; and SCFP (+) (n=9) with coinfection. Calves received SCFP in their starter grain in the AM feeding and milk replacer twice a day. Nasal swabs were collected every other day following viral infection and analyzed for viral load using RT-qPCR. Data represents ± SE. **Figure 2 and 3. Impact of lack and presence of SCFP on cytokine response and associated clinical scores.** Treatment groups are as described in Figure 1. Calves were challenged with aerosolized approximately 10^4 $TCID_{50}$ BRSV strain 375. All calves were assigned a clinical score each day by trained observers. Scores are based on fever and the severity of lung sounds, nasal discharge, eye crusting, and ear position. Data represents the average per treatment group for each day. **Figure 4. Gross pathology scores on day 10 after infection.** Treatment groups are as described in Figure 1. On day 10 post-infection all surviving calves were humanely euthanized and necropsied. The lungs of each calf were removed and scored based on the area of pneumonic or lesioned tissue. Data represents ± SE.



Cytokine Expression





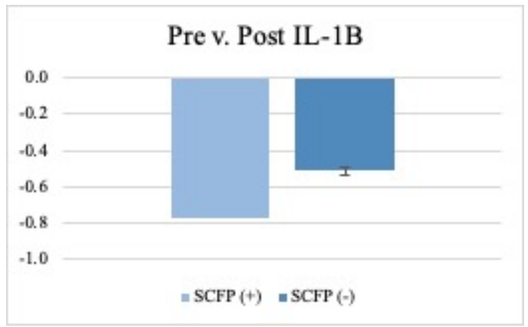


Figure 5, 6, and 7. Impact of SCFP treatment on liver cytokines (TNF-alpha, IL-1 beta, IL-6) delta-CT expression relative to a housekeeping gene. Treatment groups are as described in Figure 1. Cytokine response was quantified using liver samples and RT-qPCR. Cytokine response was analyzed using, both, pre-infection and necropsy liver biopsies. The cytokine response shown reflects the delta-CT value relative to the housekeeping gene RPS9. The data represents the difference between pre-infection and necropsy liver biopsies taken at day 0 and day 10, respectively. Data represents average per treatment groups. Data represents ± SE.

Conclusions

- SCFP is known to modulate the immune response in neonatal calves[1]
- SCFP (+) calves experienced, on average, lower viral load throughout the course of the study as compared to SCFP (-) calves
- There was not a strong correlation between clinical scores and SCFP (-) calves, but SCFP (+) calves generally experienced an increase in average clinical scores as cytokine expression increased
- Gross pathology scores improved slightly with an overall, qualitative, increase in cytokine expression
- Overall, SCFP (+) calves maintained lower nasal viral load and higher cytokine expressions compared to the SCFP (-) peak viral load
- SCFP modulates the acute-phase response
- In the future, targeting the acute-phase response may alleviate BRD in neonatal calves

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